ORDEM 3.0 and MASTER-2009 modeled small debris population comparison

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The latest versions of the two premier orbital debris engineering models, NASA's ORDEM 3.0 and ESA's MASTER-2009, have been publically released. Both models have gone through significant advancements since inception, and now represent the state-of-the-art in orbital debris knowledge of their respective agencies. The purpose of these models is to provide satellite designers/operators and debris researchers with reliable estimates of the artificial debris environment in low Earth orbit (LEO) to geosynchronous orbit (GEO). The small debris environment within the size range of 1 mm to 1 cm is of particular interest to both human and robotic spacecraft programs, particularly in LEO. These objects are much more numerous than larger trackable debris and can have enough momentum to cause significant, if not catastrophic, damage to spacecraft upon impact. They are also small enough to elude routine detection by existing observation systems (radar and telescope). Without reliable detection the modeling of these populations has always coupled theoretical origins with supporting observational data in different degrees.

In this paper, we present and detail the 1 mm to 1 cm orbital debris populations from both ORDEM 3.0 and MASTER-2009 in LEO. We review population categories: particle sources for MASTER-2009, particle densities for ORDEM 3.0. We describe data sources and their uses, and supporting models. Fluxes on spacecraft for chosen orbits are also presented and discussed within the context of each model.